REMARKS

Enclosed herewith is a Substitute Specification in which the specification as filed has been amended in various places to correct typographical and grammatical errors, and also to add section headings.

In support of the above, enclosed herewith is a copy of the specification as filed marked up with the above changes.

The undersigned attorney asserts that no new matter has been incorporated into the Substitute Specification.

The claims have been amended to more clearly define the invention as disclosed in the written description. In particular, claim 1 has been cancelled, while claim 2 has been made a proper independent claim. In addition, new claim 6 has been added and claims additional features of the invention.

The Examiner has rejected claims 1, 4 and 5 under 35 U.S.C. 102(b) as being anticipated by Japanese Patent Publication JP 09114479A to Masaharu et al. The Examiner has further rejected claims 2 and 3 under 35 U.S.C. 103(a) as being unpatentable over Masaharu et al. in view of Japanese Patent Publication JP 09084198 to Hiroshi.

The Masaharu et al. reference appears to disclose a sound filed reproducing device in which voice signals are extracted for an input stereo signal, reflected sounds are added to the resulting music signal thereby expanding the sound field of the music

signals, and then the extracted voice signals are the added to the expanded sound field music signals.

The Hiroshi reference appears to disclose a sound signal processor and surround reproducer method in which "the signal components of the frequency band in which more vocal components are contained, in particular, between the cut-off of the low frequency by the low-pass filter 21 and the cut-off of the high frequency by the high-pass filter 22 is cut to prevent a surround reproduction process from being performed for the vocal component as much as possible,…."

The subject invention, as claimed in claim 2, concerns an audio signal processing device in which the perceived direction in which the speech signals portion of combined speech and music signals is adjustable (in the Substitute Specification, see page 5, line 9 to page 6, line 6, paragraph [0014]). When viewing a relatively small television screen, the perceived position from which the speech signals originate is not important. However, with the proliferation of wide-screen television receivers, it is very desirable if the speech signal is perceived to originate from the relative position of the speaker on the television screen, as opposed to, for example, a predetermined center position. To that end, the subject invention includes means for separating the speech signals from the music signals. In addition, the subject invention includes "signal direction detection means for ascertaining a

direction from which the speech signals originate" and "converter means for converting the speech signals in accordance with a desired virtual change in the direction from which the speech signals can be heard".

Both the Masaharu et al. and Hiroshi references discloses devices for separating the voice components of the combined signal, processing the voiceless resultant signal, for example, for widening, and then re-inserting the voice components such that the voice components are not subjected to the widening processing. However, neither of these references disclose or suggest any form of processing of the separated voice components. Furthermore, neither of these references disclose or suggest determining a perceived direction of the separated voice signals, and then converting the separated voice signals in order to adjust the perceived direction of the separated voice signals.

As claimed in claim 3, the converter of the subject invention further includes "one or several additional input channels for receiving speech and position signals from a microphone having position recording means". As described in the Substitute Specification on page 2, line 20 to page 3, line 12, paragraphs [0006]-[0007], and on page 6, lines 7-12, paragraph [0015], in the case of video conferencing, by having such an additional input, the speech signals of any speaker may be able to

track that speaker whether he/she is stationary or is pacing to and fro.

As claimed in new claim 6, the signal direction detection means and the converter means of claim 2, are combined with further converter means for effecting a desired virtual spatial widening to the separated music signals.

While both Masaharu et al. and Hiroshi disclose such a widening, Applicants submit that, as discussed above, neither Masaharu et al. nor Hiroshi disclose or suggest the signal direction detection means and the converter means for adjusting a perceived direction of the speech signals.

In view of the above, Applicants believe that the subject invention, as claimed, is neither anticipated nor rendered obvious by the prior art, either individually or collectively, and as such, is patentable thereover.

Applicants believe that this application, containing claims 2-6, is now in condition for allowance and such action is respectfully requested.

Respectfully submitted,

by 
Edward W. Goodman, Reg. 28,613
Attorney
Tel.: 914-333-9611

CERTIFICATE OF MAILING

It is hereby certified that this correspondence is being deposited with the United States Postal Service as First-class mail in an envelope addressed to:

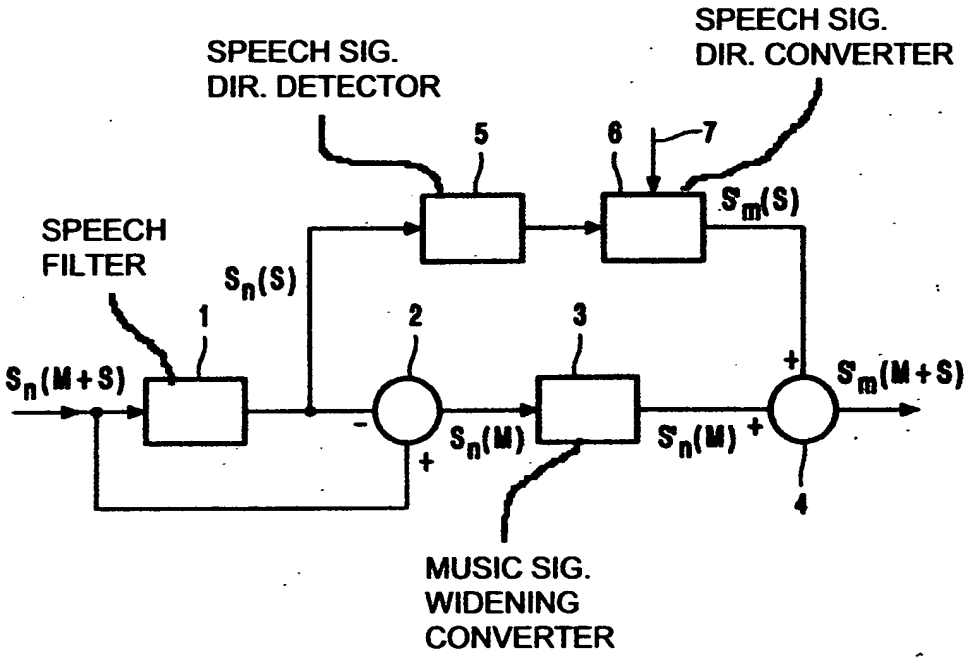
COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, VA 22313-1450

On December 22, 2003

By Burnett James

ANNOTATED SHEET SHOWING CHANGES

1/1



#12 (N.E.)
B.D.
12/31/03

PHN 17,834

AUDIO SIGNAL PROCESSING DEVICE

BACKGROUND OF THE INVENTION

Field Of The Invention

[0001] The invention relates to an audio signal processing device for speech and music signals.

Description Of The Related Art

[0002] Although the speech and ~~sound~~ music signals come from a certain direction defined by an arrangement of loudspeakers, there is, nevertheless, a demand that speech and music signals should seem to come from different directions, as perceived by listeners.

SUMMARY OF THE INVENTION

[0003] To achieve this object, the audio signal processing device, according to the invention, is provided with signal supply means for supplying speech and music signals over one or several (n) different input channels, separation means for substantially separating the speech and music signals, first converter means for converting the music signals in accordance with a desired virtual spatial widening from which the music signals can be heard through one or several (m) different output channels, and combination means for combining the speech signals with the converted music signals.

[0004] It is true for the case in which n = 2 and m = 2, i.e., for conventional stereo sound reproduction, for example, with the

use of headphones, that music can be heard with a virtual spatial spread through the use of an audio signal processing device according to the invention, and speech can be equally distributed over the two channels (left and right) as a mono signal, or can be heard through one of the two channels (left or right). The music heard in a wider spatial virtual spread is referred to hereinafter as "widened" music for short. The device according to the invention renders it possible, accordingly, to widen music but not speech, and can be effective both for speech and music signals separately and for the simultaneous reproduction of speech and music.

[0005] Since it may be desirable, in certain circumstances, to have the speech appear from any ~~other~~ desired direction ~~desired~~, it is ~~possible~~ furthermore possible, according to the invention, that signal direction detection means ~~are~~ is present for ascertaining the direction from which the speech signals originate, and second converter means for converting the speech signals in accordance with a desired virtual change in the direction from which the speech signals can be heard, the converted speech signals and the converted music signals being joined together in the combination means.

[0006] This measure renders it possible, for example, that speech is still being heard through headphones from the direction of a speaker, whether the latter is stationary or is walking to and fro, or even if several speakers are present who address an auditorium consecutively from different spatial angles. The

measures according to the invention may also be important for video-conferencing, where the speech can also be made to originate from the direction of the speaker on a displayed video picture and not from the direction from which image and sound were recorded. It may be especially unpleasant and adversely affect the ease of understanding of speech when the perceived directions of image and sound do not coincide.

[0007] The second converter means mentioned above may be provided with one or several additional input channels through which speech and position signals can be supplied from a microphone having position recording means. Speech signals from a further speaker can be ~~put in~~inserted in this manner, and be reproduced as though coming from the direction of this speaker.

[0008] The invention further relates to an audio reproduction system provided with an audio signal processing device as described above, and with sound reproduction means for the separate output channels for rendering amplified speech and music signals audible.

[0009] The invention also relates to an audiovisual reproduction system provided with an audio signal processing device as described above and to a unit in which a picture screen and sound reproduction means are incorporated.

BRIEF DESCRIPTION OF THE DRAWING

[0010] The invention will now be explained in more detail below with reference to the accompanying drawing, in which:

[0011] The sole figure is a block diagram representing the functions of the audio signal processing device according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0012] The Figure ~~shown in the drawing~~ shows a speech filter 1 in which the n input signals $S_n(M+S)$ are filtered, only the speech signals $S_n(S)$ ~~only~~ being present at the output. The music signals $S_n(M)$ are obtained by subtracting the speech signals from the input signals ~~and the speech signals by~~in differentiating means 2. In practice, the speech filter and the differentiating means together form separating means for substantially separating the speech signals from the music signals. Such separating means are known per se from Karaoke techniques and are based on the effect, for example, that speech is present in a certain frequency band or is distributed over the input channels with a fixed weighting or a weighting which changes with the movement of speakers.

[0013] The music signals $S_n(M)$ are converted to so-called widened music signals $S_m'(M)$ in (first) converter means 3 in accordance with a desired virtual spatial widening from which the music signals can be heard through the individual channels. The number of input channels n obviously need not be equal to the number of output channels m. Such music widening techniques are also known per se, for example, from ~~US-A~~ U.S. Patent 5,742,687. Finally, the speech signals $S_n(S)$ can be combined again with the

widened music signals by combination means 4. The music signals are widened in this manner, whereas the speech signals are perceived as coming from the original direction. If two channels are present, and music and speech are amplified and reproduced through two loudspeakers L (left) and R (right), it can be achieved with this system that the music is perceived as coming from two virtual loudspeakers, while the speech is perceived as coming from both or one of the two loudspeakers.

[0014] Since it may be desirable that also the speech signals can be perceived as coming from an adjustable direction, the audio signal processing device shown in the Figure is, in addition, provided with signal direction detection means 5 and second converter means 6. The direction from which the speech signals originate is ascertained in the signal direction detection means, for example, through the use of known PCA (principal component analysis) techniques. The speech signals are converted to speech signals $S_m'(S)$ in the second converter means 6 in accordance with a desired virtual change in the direction from which the speech signals can be heard. The signals are subjected to a matrix multiplication in a known manner, the matrix coefficients for the desired virtual channels being determined by calibration, so as to achieve that the signals transmitted through real channels are perceived as coming through virtual channels. If two channels are present, and speech is transmitted in amplified form through two loudspeakers L (left) and R (right), for example, both equally

strongly, such a matrix multiplication achieves that a stronger signal is perceived as coming from the one loudspeaker than from the other loudspeaker, which means that the speech is perceived as coming from a different (virtual) direction, defined by the matrix coefficients, as compared with the original direction defined by the loudspeakers.

[0015] The second converter means 6 mentioned above may, in addition, be provided with one or several additional input channels 7 through which speech and position signals can be supplied from a microphone which has position detection means. Speech signals from a further speaker can thus be ~~put in~~inserted and reproduced as if they were coming from the direction of this speaker.

[0016] The converted speech and music signals may be joined together again by the combination means 4 into signals $S_m'(M+S)$. The music signals are thus widened, while the speech signals are perceived as coming from a direction which may be adjusted. If two channels are present, and music and speech are transmitted in amplified form through two loudspeakers L (left) and R (right), it is possible, by means of this system, to achieve that the music is perceived as coming from two virtual loudspeakers, whereas the speech is perceived as coming from a certain, selected direction.

[0017] It will be obvious that the invention is not limited to applications in which only two input and output channels are present. Any number of input and output channels desired, in practice, is possible. Thus, a monosignal $S_1(M+S)$ may be supplied

to the audio processing device through an input channel, and a specific speech signal through the additional input channel, while the output signal is reproduced in mono or in stereo, for example, in the case of video-conferencing. Such a situation is comparable to that in which signals $S_2(M+S)$ are supplied to the audio signal processing device through two separate input channels.

ABSTRACT~~:~~ OF THE DISCLOSURE

An audio signal processing device ~~comprises~~ includes a signal supply ~~means to supply~~for supplying speech and music signals via one or more input channels.

~~———————~~ The device further ~~comprises separating means~~includes a signal separator for separating ~~to separate~~ the speech and music signals. ~~First~~ A first converter ~~means are used to convert~~converts the music signals into ~~a required~~ desired virtual ~~widening~~ widened signals from one or more input channels. ~~Combination means are~~A signal combiner used to combine the speech signals with the ~~converted~~ widened music signals.

~~Fig.~~